

# Cognitive Complexity

Retrieved 2/1/13 from Minnesota Comprehensive Assessments: Mathematics Test Specifications for MCA-III, Grades 3–8 and MCA-Modified, Grades 5–8, January 24, 2013, pp. 11-12.

<http://education.state.mn.us/MDE/EdExc/Testing/TestSpec/>

Cognitive complexity refers to the cognitive demand associated with an item. The level of cognitive demand focuses on the type and level of thinking and reasoning required of the student on a particular item. MCA-III and MCA-Modified levels of cognitive complexity are based on Norman L. Webb's Depth of Knowledge<sup>3</sup> levels.

**A Level 1 (recall) item** requires the recall of information such as a fact, definition, term or simple procedure, as well as performing a simple algorithm or applying a formula. A well-defined and straight algorithmic procedure is considered to be at this level. A Level 1 item specifies the operation or method of solution and the student is required to carry it out.

**A Level 2 (skill/concept) item** calls for the engagement of some mental processing beyond a habitual response, with students required to make some decisions as to how to approach a problem or activity. Interpreting information from a simple graph and requiring reading information from the graph is a Level 2. An item that requires students to choose the operation or method of solution and then solve the problem is a Level 2. Level 2 items are often similar to examples used in textbooks.

**Level 3 (strategic thinking) items** require students to reason, plan or use evidence to solve the problem. In most instances, requiring students to explain their thinking is a Level 3. A Level 3 item may be solved using routine skills but the student is not cued or prompted as to which skills to use.

**Level 4 (extended thinking) items** require complex reasoning, planning, developing and thinking, most likely over an extended period of time. Level 4 items are best assessed in the classroom, where the constraints of standardized testing are not a factor.

Using these cognitive complexity levels to categorize items ensures that the complexity of the test items matches the complexity of the content domain assessed. Based on the benchmarks included in the Mathematics MCA-III and Mathematics MCA-Modified, Table 1 indicates the target proportion of test items at each cognitive level included in each test.

**TABLE 1.** Cognitive Level Target Minimum Distribution of Items in Mathematics for the MCA and MCA-Modified

Grades	Level 1	Level 2	Level 3
3–8	20%	30%	5%

<sup>3</sup> Webb, N. L. *Alignment of science and mathematics standards and assessments in four states* (Research Monograph No. 18). Madison: University of Wisconsin – Madison, National Institute for Science Education, 1999.